

## Predicting Heredity

### Gene Symbols

All organisms have at least two genes for every trait. They receive at least one from each parent. Symbols are used to help in predicting the traits of offspring. A **capital letter** is used to represent a dominant trait. A **lowercase letter** is used to represent a recessive trait. In humans, brown eyes are dominant. The symbol for this gene is *B*. The gene for blue eyes is recessive. The symbol for this gene is *b*. A capital letter shows that the gene for that trait is dominant. A lowercase letter shows that the gene for that trait is recessive. If black fur color in guinea pigs was a dominant trait, what symbol would be used for that gene? If you're thinking that it is a capital *B*, you're right. A guinea pig with white fur is a recessive trait, so the symbol for that gene is represented with a lowercase *b*.

### Punnett Squares

One way to predict heredity is to use a special chart called a Punnett square. A Punnett square shows the possible gene combinations for a trait and consists of four boxes inside a square. Each square represents a possible gene combination. The parents' genes are placed outside the square. The steps below will show you how to predict the possible gene combinations from two parents.

- Draw a box with four squares.
- Write the genes from the mother down the left side of the square.
- Write the genes from the father across the top of the square.
- Fill in each of the four boxes by giving one gene from each parent to each box—one gene from the mother and one gene from the father.

Example of a Punnett square:

|          |           |           |
|----------|-----------|-----------|
|          | <i>B</i>  | <i>b</i>  |
| <i>B</i> | <i>BB</i> | <i>Bb</i> |
| <i>b</i> | <i>Bb</i> | <i>bb</i> |

### Incomplete Dominance

In most sports, there is usually a stronger team and a weaker team. Which team usually wins? What happens if the two teams are equally matched? Heredity can work like that too. If the gene is dominant, it usually wins over the weaker recessive gene. Some genes of certain traits are equally strong. We call this incomplete dominance. In these traits, a mixture of both traits shows up in the offspring. This kind of gene combination is called blending. In some flowers, the color red (*RR*) is equally as strong in heredity as the color white (*WW*). If neither color is dominant, the offspring will be a combination or blending of the two colors red and white. If neither color is dominant, what color will the offspring be? If you are thinking red and white make pink, then you're absolutely right. Since neither color can hide the other color, a blending of the two occurs. A Punnett square for the cross-pollination of these two flowers is demonstrated on the next page.



## Predicting Heredity (cont.)

|          |           |           |
|----------|-----------|-----------|
|          | <i>R</i>  | <i>R</i>  |
| <i>W</i> | <i>RW</i> | <i>RW</i> |
| <i>W</i> | <i>RW</i> | <i>RW</i> |

The offspring of crossed pure red and pure white flowers are a blending of the two colors. How can you tell, observers, from looking at the chart above, that there is incomplete dominance? If you're thinking because two capital letters are used to symbolize their gene combinations, you're correct. Incomplete dominance produces offspring with hybrid genes for the given trait, and neither one is dominant over the other for that trait. Examples in humans of incomplete dominance are found in skin, hair, and eye color. Let's hear it for the green-eyed people!

### Genotypes and Phenotypes

The genetic makeup of an organism is its **genotype**. The genotype of the pink flowers is *RW*. The genotype of the red flower is *RR*, and the white flower's genotype is *WW*. The capital letters indicate incomplete dominance. The genotype is the combination of genes for each trait the organism has. The physical trait that shows as a result of the genotype is the **phenotype**. The phenotype for *RW* is the color pink. Remember, you can not always figure out the genotype by looking at the phenotype. The gene combination *TT* and *Tt* both produce tall pea plants, giving them the same phenotype or physical characteristic. The capital *T* that indicates tallness in pea plants is a dominant trait. *TT* is pure dominant and *T* is dominant over *t* in the hybrid tall pea plant. Both plants are tall pea plants, but each has a different genotype. Explore the examples below to gain a better understanding of the terms genotype and phenotype.

| Trait           | Genotype  | Phenotype   |
|-----------------|-----------|-------------|
| 1. Red flower   | <i>RR</i> | Red Color   |
| 2. White flower | <i>WW</i> | White Color |
| 3. Pink flower  | <i>RW</i> | Pink Color  |
| 4. Brown eyes   | <i>BB</i> | Brown Color |
| 5. Blue eyes    | <i>bb</i> | Blue Color  |
| 6. Brown eyes   | <i>Bb</i> | Brown Color |
| 7. Tall plant   | <i>TT</i> | Tallness    |
| 8. Short plant  | <i>tt</i> | Shortness   |
| 9. Tall plant   | <i>Tt</i> | Tallness    |